

Specification:

Page 1, the first paragraph, replace with the following new paragraph:

--- This invention is generally relative to ~~short-range wireless~~ a dual-mode ~~transceiver of~~ ultra wideband ~~communications~~ (UWB) and wireless local area network (WLAN) communications.

Page 1, the second paragraph, replace with the following new paragraph:

--- On April 22, 2002, U.S. Federal Communications Commission (FCC) released the revision of Part 15 of the Commission's rules regarding UWB transmission systems to permit the marketing and operation of certain types of new products incorporating UWB technology. With appropriate technology, UWB ~~device~~ devices can operate using spectrum occupied by existing radio service without causing interference, thereby permitting scarce spectrum resources to be used more efficiently. The UWB technology offers significant benefits for Government, public safety, businesses and consumers under an unlicensed basis of operation spectrum.

Page 1, the last paragraph (extends to page 2), replace with the following new paragraph:

--- The UWB ~~device~~ devices can be classified ~~[[in]]~~ into three types based on the operating restrictions: (1) imaging ~~system~~ systems including ground penetrating radars and wall, through-wall, surveillance, and medical imaging device, (2) vehicular radar systems, and (3) communications and measurement systems. In general, FCC is adapting unwanted emission limits for the UWB devices that are significantly more stringent than those imposed on other Part 15 devices. In other words, FCC limits outdoor use of the UWB ~~device~~ devices to imaging systems, vehicular radar systems and handheld devices. Limiting the frequency bands, which is based on the -10 dB bandwidth of the UWB emission~~[[,]]~~ within certain UWB ~~product~~ products, will be permitted to operate. For the communications

and measurement systems, FCC provides a wide variety of the UWB devices, such as high-speed home and business networking devices as well as storage tank measurement devices under the Part 15 of the Commission's rules subject to certain frequency and power limitations. The UWB ~~device~~ devices must operate in the frequency band from 3.1 GHz to 10.6 GHz. The UWB ~~communication~~ devices should also satisfy by the Part 15.209 limit, which sets emission limits for indoor and outdoor UWB ~~system~~ systems, for the frequency band below 960 MHz, and the FCC's emission masks for the frequency band above 960 MHz.

Page 3, the first paragraph, replace with the following new paragraph:

--- The outdoor handheld UWB communication ~~systems~~ devices are intended to operate in a peer-to-peer mode without restriction on location. However, the outdoor handheld UWB communication ~~device~~ devices must operate in the frequency band from 3.1 GHz to 10.6 GHz as well, with an extremely conservative out of band emission masks to address interference with other communication devices. The outdoor handheld UWB communication devices are permitted to emit at or below the Part 15.209 limit in the frequency band below 960 MHz. The emissions above 960 MHz for the outdoor handheld UWB communication devices must conform to the following emission masks as shown in Table 2:

Table 2

Frequency (MHz)	EIRP (dBm)
0-960	-41.3
960-1610	-75.3
1610-1900	-63.3
1900-3100	-61.3
3100-10600	-41.3
Above 10600	-61.3

Page 3, the second paragraph (extends to page 4), replace with the following new paragraph:

--- FCC proposed to define a UWB device as any device where the fractional bandwidth is greater than 0.25 based on the formula as follows:

$$FB = 2 \left(\frac{f_H - f_L}{f_H + f_L} \right), \quad (1)$$

where f_H ~~[[is]]~~ and f_L are the upper and lower frequency frequencies of the -10 dB emission points, respectively, ~~and f_L is the lower frequency of the -10 dB emission point.~~ The center frequency of the UWB transmission is defined as the average of the upper and lower -10 dB points. That is

$$F_c = \frac{f_H - f_L}{2}. \quad (2)$$

In addition, a minimum bandwidth of 500 MHz must be used for indoor and outdoor UWB devices regardless of center frequency.

Page 4, the last paragraph, replace with the following new paragraph:

--- The indoor UWB communication devices must be designed to ensure that operation can only occur indoor according to the indoor emission masks in Table 1, ~~or it must consist of~~ The outdoor hand-held handheld UWB communication devices that may be employed for such activities as peer-to-peer operation must be designed according to the outdoor emission masks in Table 2. Both of the indoor and outdoor ~~[[Such]]~~ UWB communication devices can be used for wireless communications, particularly for short-range high-speed data transmissions suitable for broadband access to networks.

Page 4, the last paragraph (extends to page 5), replace with the following new paragraph:

--- [[The]] UWB communication transceiver for the indoor and outdoor operation can transmit and receive [[the]] UWB signals by using one channel and/or up to 11 channels in parallel according to some embodiments of the present invention. Each channel of the UWB communication transceiver has a frequency bandwidth of 650 MHz that can transmit 40.625 [[Msps]] Mega bits per second (Mbps). That is, a total of 11 channels are able to transmit 446.875 [[Msps]] Mbps. The UWB communication transceiver also employs the orthogonal spread codes for all the channels. With 16 [[PN]] pseudorandom noise (PN) spread sequence codes for each bit, each channel achieves 650 [[Mcps]] Mega chips per second (Mcps). The UWB communication transceiver for the indoor and outdoor operation can transmit and receive the chip data rate up to 7.150 [[Gcps]] Giga chips per second (Gcps).

Page 5, the second paragraph, replace with the following new paragraph:

--- WLAN 802.11a is an IEEE standard for wireless LAN medium access control (MAC) and physical layer (PHY) specification and is also referred to as the high-speed physical layer in the 5 GHz band. The WLAN 802.11a standard specifies a PHY entity for an orthogonal frequency division multiplexing (OFDM) system. The radio frequency LAN communication system is initially aimed for the lower band of the 5.15 – 5.35 GHz and the upper band of the 5.725 – 5.825 GHz unlicensed national information structure (U-NII) bands, as regulated in the United States by the code of Federal Regulations under Title 47 and Section 15.407. The WLAN 802.11a communication system provides the data payload rate of 6, 9, 12, 18, 24, 36, 48 and 54 ~~Mbit/s~~ Mbps. Also, the WLAN 802.11a communication system supports the transmitting and receiving at data rate of 6, 12, and 24 ~~Mbit/s~~ Mbps with mandatory. The

WLAN 802.11a communication system uses 52 subcarriers with modulation of using binary or quadrature phase shift keying (BPSK/QPSK), 16-quadrature amplitude modulation (QAM), or 64-QAM. The forward error correction coding (FEC) of convolutional encoding is used with a coding rate of 1/2, 2/3, or 3/4.

Page 6, the first paragraph, replace with the following new paragraph:

--- The UWB communication transceiver can achieve the transmission distance in a range of 3 meters to 10 meters since the UWB communication transceiver has to transmit the data with very-low power due to the restriction of FCC emission limitation for the indoor and outdoor operation. The UWB communication transceiver can transmit and receive a very-high data rate in the range from 40.625 to 446.875 [[Msp]] Mbps according to some embodiments of the present invention. On the other hand, the WLAN 802.11a communication system can only transmit and receive the data rate in a range from 6 to 54 Mbps, but with a longer transmission distance up to 100 meters.

Page 6, the second paragraph, replace with the following new paragraph:

--- Since the UWB communication transceiver for the indoor and outdoor operation can transmit and receive the very-high data rate with the short-distance while the WLAN 802.11a communication system can transmit and receive the data up to a much longer distance than the UWB device, but has a lower transmission data rate for the device. Therefore, developing a ~~dual-mode~~ dual-mode transceiver of the UWB communication system for the indoor and outdoor operation and the WLAN 802.11a communication system is very important since [[the]] trade-offs of the transmission distance and data rate between the UWB and the WLAN 802.11a ~~transmission distance and data rate~~ transceiver can be mutually utilized each other for benefits. ~~thereby having a~~ This allows the

UWB and WLAN 802.11a transceiver with co-existence in an environment.

Page 7, the second paragraph, replace with the following new paragraph:

--- In accordance with one aspect, the dual-mode [[UWB]] ultra wideband and [[WLAN]] wireless local area network transceiver includes a digital lowpass-shaping filter system coupled to a [[UWB]] ultra wideband multichannel [[PN]] pseudorandom noise sequence mapping or coupled to a ~~WLAN-IFFT~~ wireless local area network inverse fast Fourier transform and [[I/Q]] image/quadrature modulation, a dual-mode sampling frequency rate coupled to a digital-to-analog converter, and a switch to connect from the [[UWB]] ultra wideband multichannel [[PN]] pseudorandom noise sequence mapping or the ~~WLAN-IFFT~~ wireless local area network inverse fast Fourier transform and [[I/Q]] image/quadrature modulation to the digital lowpass-shaping filter system.

Page 9, the third paragraph (extends to page 10), replace with the following new paragraph:

--- FIG. 1 illustrates the dual-mode UWB and WLAN 802.11a communication transceiver 100 in accordance with one embodiment of the present invention. This dual-mode UWB and WLAN 802.11a communication transceiver 100 includes a dual-mode UWB and WLAN multi-carrier RF section 114 that receives and/or transmits multichannel UWB and WLAN 802.11a signals from an antenna [[112]] 110 or to an antenna [[110]] 112. The dual-mode UWB and WLAN multi-carrier RF section 114 is connected with an analog and digital interface section 116 that contains analog-to-digital (A/D) and digital-to-analog (D/A) converters. The analog and digital interface section 116 is coupled to an UWB and WLAN 802.11a digital processing section 118, which performs dual-mode multichannel digital transmission and receiver filtering, rake

processing, OFDM, channel estimator, spread/de-spread processing, interleave/de-interleave, and ~~code/de-code~~ encoder/decoder processing. The UWB and WLAN 802.11a digital processing section 118 has an interface with a UWB or WLAN 802.11a network interface section 120 in which is coupled to a UWB or WLAN 802.11a network 122. In accordance with one embodiment of the present invention, the transceiver 100 is the so-called dual-mode UWB and WLAN 802.11a communication transceiver that can both transmit and receive speech, audio, images and video and data information for the indoor and/or outdoor wireless broadband communications.

Page 10, the third paragraph (extends to page 11), replace with the following new paragraph:

--- During the UWB mode, the UWB transmitter 200 receives user data bits 210 with information data rate at 223.4375 Mbps. The information data bits 210 are passed through a 1/2-rate convolution encoder 212 that may produce the double data rate of 446.875 ~~[[Msps]]~~ Mbps by adding redundancy bits. The ~~symbol~~ bit data is then interleaved by using a block interleaver 214. A switch 234 is connected to a position of 236A under a software control unit 228. Then, the output ~~symbols~~ bits of the block interleaver 214 are formed 11 multichannels by using a multichannel PN sequence mapping 218. The ~~symbol~~ bit data rate of each channel is about 40.625 ~~[[Msps]]~~ Mbps. The multichannel PN sequence mapping 218 is used to perform spreading for one ~~symbol~~ bit data with 16 orthogonal spread sequence chips and to produce 650 Mcps for each channel under the software control unit 228. A PN sequence look-up table 216 provides the unique orthogonal sequences for each channel spreading. A switch 240 that is controlled by using the software control unit 228 is connected with a position 238A. Then chip data of each channel is sequentially passed through an outdoor digital lowpass shaping ~~[[FIR]]~~ finite impulse response

(FIR) filter system 220 to limit the frequency bandwidth with 650 MHz for each channel signal. Each channel signal is passed through a D/A converter 222, which has the 6-bit resolution and sampling frequency rate of 1 GHz provided by a dual-mode sampling rate 240. The software control unit 228 controls the dual-mode sampling rate 240. The output chip data of each channel from the D/A converter 222 is then modulated with a multi-carrier by using a multichannel-based multi-carrier 224 with controlling from the software control unit 228. Thus, the output analog signals of the multichannel-based multi-carrier 224 are passed a power amplifier (PA) 226 through an antenna into air.

Page 12, the first paragraph (extends to page 13), replace with the following new paragraph:

--- During the WLAN 802.11a mode, the WLAN 802.11a transmitter 200 receives user data bits 210, which are passed through a 1/2-rate, 2/3-rate or 3/4-rate convolution encoder 212 that may produce 2-times or 3/2-times or 4/3-times data rate by adding redundancy bits. The ~~symbol~~ bit data is then interleaved by using the interleaver unit 214. The switch 234, which is controlled by using the software control unit 228, is connected to a position 236B. Then, the output ~~symbol~~ bits of the interleaver unit 214 are formed the data in parallel to be used for a 64-point IFFT unit 230. The output of the 64-point IFFT unit 230 is performed for an image/quadrature (I/Q) [[I/Q]] modulation 232. The switch 240 that is controlled by using the software control unit 228 is connected with a position 238B. Then output data of the I/Q modulation 232 is passed through the digital lowpass shaping FIR filter system 220 to limit the frequency bandwidth with ~~[[60]]~~ 20 MHz for the channel signal. The channel signal is passed through the D/A converter 222, which has the 6-bit resolution and the oversampling frequency rate of ~~[[720]]~~ 480 MHz provided by the dual-mode sampling rate 240. The software control unit 228 controls the dual-

mode sampling rate 240. The output from the D/A converter 222 is then modulated with a multi-carrier by using the multichannel-based multi-carrier 224 with controlling from the software control unit 228. Thus, the output analog signals of the multichannel-based multi-carrier 224 are passed the power amplifier 226 through an antenna into air.

Page 13, the second paragraph, replace with the following new paragraph:

--- Referring to FIG. 3 is a detailed block diagram 300 of showing the dual-mode sampling frequency rate 220 according to some embodiments. A UWB sampling frequency unit 310 supports the sampling rate at 1 GHz while a WLAN sampling frequency unit 320 provides over-sampling rate of ~~[[720]]~~ 480 MHz for the use in the D/A converter 222 of FIG. 2. During the UWB mode, a MUX unit 330, which is controlled by using a selectable unit 340, passes through the UWB sampling frequency unit 310 as the output-sampling rate. During the WLAN mode, the MUX unit 330 passes through the WLAN sampling frequency unit 320 as the output-sampling rate. Thus, the D/A converter 222 operates under controlling the sampling frequency rate either with UWB of 1 GHz or with WLAN of ~~[[720]]~~ 480 MHz. The software control unit 228 controls the selectable unit 340.

Page 16, the last paragraph (extends to page 17), replace with the following new paragraph:

--- FIG. 8 is the outdoor UWB output of multi-carrier frequency spectrums (dBm) 800 including 11 transmitter channel spectrums 820A-820K along with the outdoor FCC emission limitation 810 according to some embodiments. Each channel frequency bandwidth is 650 MHz and is fitted under the outdoor FCC emission limitation 810 with different carrier frequencies. The detail positions of each transmitter channel spectrums (dBm) along with the center, lower and upper frequencies (GHz) as well

as channel frequency bandwidth (MHz) are also showed in Table 3[[.]],
where the label of transmitter channel frequency spectrums are from
820A, ..., 820J, and 820K.

Page 17, the second paragraph (extends to page 18), replace with the following new paragraph:

--- FIG. 9 is the WLAN 802.11a output of multi-carrier frequency spectrum (dB) 900 including 8 lower transmitter spectrums 910A-910H and 4 upper transmitter spectrums 920A-920D according to some embodiments. Each channel frequency bandwidth is [[60]] 20 MHz. The detail positions of each transmitter channel spectrums (dB) along with the center, lower and upper frequencies (GHz) as well as channel frequency bandwidth (MHz) are listed in Table 4.

Table 4

Label of transmitter channel frequency spectrums	Center Frequency (MHz)	Lower Frequency (MHz)	Upper Frequency (MHz)	Frequency Bandwidth (MHz)
910A	5180	5150 <u>5170</u>	5210 <u>5190</u>	[[60]] <u>20</u>
910B	5200	5170 <u>5190</u>	5230 <u>5210</u>	[[60]] <u>20</u>
910C	5220	5190 <u>5210</u>	5250 <u>5230</u>	[[60]] <u>20</u>
910D	5240	5210 <u>5230</u>	5270 <u>5250</u>	[[60]] <u>20</u>
910E	5260	5230 <u>5250</u>	5290 <u>5270</u>	[[60]] <u>20</u>
910F	5280	5250 <u>5270</u>	5310 <u>5290</u>	[[60]] <u>20</u>
910G	5300	5270 <u>5290</u>	5330 <u>5310</u>	[[60]] <u>20</u>
910H	5320	5290 <u>5310</u>	5350 <u>5330</u>	[[60]] <u>20</u>
920A	5745	5715 <u>5735</u>	5775 <u>5755</u>	[[60]] <u>20</u>
920B	5765	5735 <u>5755</u>	5795 <u>5775</u>	[[60]] <u>20</u>
920C	5785	5755 <u>5775</u>	5815 <u>5795</u>	[[60]] <u>20</u>
920D	5805	5775 <u>5795</u>	5835 <u>5815</u>	[[60]] <u>20</u>

Page 18, the last paragraph (extends to page 19), replace with the following new paragraph:

--- During the UWB mode, a low noise amplifier (LNA) 1010, which is coupled to a multichannel-based multi-carrier down converter 1012, receives the UWB signals from an antenna. The output of LNA 1010 is passed through the multichannel-based multi-carrier down converter 1012 to produce the baseband signal for an A/D converter 1014, with 6-bit resolution and sampling frequency rate at ~~720 MHz~~ 1 GHz. The software control unit 228 controls the multichannel-based multi-carrier down converter 1012, the A/D converter 1014 and a dual-mode digital receiver filter system 1016. The bandlimited UWB analog signals are then sampled and quantized by using the A/D converter 1014. The digital signals of the output of the A/D converter 1014 are filtered by using an digital receiver lowpass filter 1016 to remove the out of band signals. A switch 1042, which is also controlled by using the software control unit 228, is connected to a position 1040A. Thus, the output data of the digital receiver lowpass filter 1016 is used for a rake receiver 1020. The rake receiver 1020 calculates correlation between the received UWB signals and the channel spread sequences and performs coherent combination. The output of the rake receiver 1020 is passed to an equalizer 1022 to eliminate inter-symbol interference (ISI) and inter-channel interference (ICI). A channel estimator 1024 is used to estimate the channel phase and frequency that are passed into the rake receiver 1020 and the equalizer 1022. Then, the output of the equalizer 1022 produces the signals for a de-spreading of PN sequence and de-mapping 1026 to form the UWB signals of ~~symbol bit~~ rate at 446.875 [[Msps]] Mbps. A switch 1046 is connected to a position 1044A. Thus, the ~~symbol bit~~ data is de-interleaved by using a block de-interleaver 1036. The output data of the block de-interleaver 1036 is used for the Viterbi decoder 1038 to decode the encoded data and to produce the information data bits at 223.4375 Mbps.

Page 19, the last paragraph (extends to page 20), replace with the following new paragraph:

--- During the WLAN 802.11a mode, the low noise amplifier (LNA) 1010, which is coupled to the multichannel-based multi-carrier down converter 1012, receives the WLAN 802.11a signals from an antenna. The output of LNA 1010 is passed through the multichannel-based multi-carrier down converter 1012 to produce the baseband signal for the A/D converter 1014, with 6-bit resolution and sampling frequency rate at ~~[[720]]~~ 480 MHz. The software control unit 228 controls the multichannel-based multi-carrier down converter 1012, the A/D converter 1014 and the dual-mode digital receiver filter system 1016. The bandlimited WLAN 802.11a analog signals are then sampled and quantized by using the A/D converter 1014. The digital signals of the output of the A/D converter 1014 are filtered by using the digital receiver lowpass filter 1016 to remove the out of band signals. The switch 1042, which is also controlled by using the software control unit 228, is connected to a position 1040B. Thus, the output data of the digital receiver lowpass filter 1016 is used for an I/Q demodulation 1030. A FFT unit 1032 is used to the output signal of the I/Q demodulation 1030. The output signal of the FFT unit 1032 is converted from parallel signal into serial signal by using a mapping unit 1034. The switch 1046 is connected to a position 1044B. The channel estimator 1024 is used to estimate the channel phase and frequency that are passed for the FFT unit 1032. Then, the ~~symbol~~ bit data is de-interleaved by using the block de-interleaver 1036. The output data of the block de-interleaver 1036 is used for the Viterbi decoder 1038 to decode the user-encoded data.